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Forest Pest Management Report

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Douglas-fir Tussock Moth Monitoring in Arizona, 1992

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ABSTRACT

An early warning system to detect incipient outbreaks of the Douglas-fir tussock moth was installed at several locations in central Arizona. Pheromone traps were placed at three locations on the Tonto National Forest in 1992. Sub-outbreak population levels were detected in the Pinal Mountains near Globe where trap catch averaged 35.3 moths per trap. Very low populations were detected in the Sierra Ancha Mountains north of Globe, where an average of 2.9 moths were caught per trap at three locations. No moths were trapped along the Mogollon Rim north of Payson. Defoliation, larvae, and a few cocoons were observed on understory white fir and Douglas-fir trees in the Pinal Mountains in 1992. Visible defoliation of white fir and Douglas-fir is anticipated in the Pinal Mountains during the summers of 1993 or 1994. Future Forest Pest Management survey plans and technical information of the biology, effects, and management of Douglas-fir tussock moth are discussed.

INTRODUCTION

Outbreaks of the Douglas-fir tussock moth (DFTM), Orgyia pseudotsugata, occur periodically in some mixed conifer forests of the Southwest. During outbreaks, defoliation of white fir and Douglas-fir can be severe.

In Arizona, there are two known historic outbreak areas, the Pinal Mountains and Sierra Ancha Mountains, near Globe on the Tonto National Forest (Lessard 1975). The last known outbreak occurred in these locales in the late 1960s and early 1970s (Lessard 1975) when 800 acres was defoliated on Baker Mountain in the Sierra Ancha Mountains and 400 acres sustained moderate to heavy defoliation on Signal Peak in the Pinals. The largest outbreak in these areas occurred in the late 1950s when 3,000 acres were defoliated on Signal Peak, and 5,700 acres sustained defoliation in the Sierra Ancha Mountains. The known distribution of DFTM in Arizona also includes the Mogollon Rim, and Mt. Graham (Lessard 1975).

The DFTM is very difficult to find except during outbreaks, which can develop rapidly and with little notice. To assist with providing some advance notice of outbreaks, an early warning system was developed in the 1970s (Daterman et. al. 1974) and is now used throughout much of the Intermountain West. This survey system uses traps baited with a synthetic version of the female moth sex attractant or pheromone. The traps capture male tussock moths in late summer and early fall during the mating season. The number of moths caught provides an indication of the number of larvae that will be present the following spring and the potential for defoliation. When average captures exceed 25 or more male moths, visible defoliation may be expected within the next two summer seasons.

METHODS

Pheromone traps and lures were provided by the Methods Application Group, Forest Pest Management, in Fort Collins, Colorado. Traps were placed in three areas in Central Arizona, (Figure 1) where DFTM has been known to occur at either outbreak or endemic levels. These areas include the Pinal Mountains, Sierra Ancha Mountains, and the Mogollon Rim (near Payson). In the areas selected, mixed conifer forest species such as white fir and Douglas-fir, predominated. At each area, one or more plots were selected to place a set of traps (Figures 2-4). At each plot five traps were placed in a looping configuration, each trap separated from the next by a minimum of 75 feet (23 meters), as described by Daterman (1974). Traps were placed in a relatively open grown tree or at the edge of a dense thicket. Traps were hung in mid-July and recovered in early November. Both when plots were selected and the traps hung and retrieved, general observations were made concerning DFTM in the sample locations.

RESULTS AND DISCUSSION

Trapping

Survey results are shown in Tables 1-2. Trap captures exceeded the 25 moth threshold at the two plots in the Pinal Mountains, Icehouse and Lower Pinal, where the overall average moth catch per trap was 35.3 moths (Table 1). Average catch was slightly higher for the Icehouse plot (38.2 moths) than for the Lower Pinal Plot (32.5 moths). These results indicate that visible defoliation may be anticipated in this area during either the 1993 or 1994 summer seasons, if populations continue to increase.

Trap catches were very low in the Sierra Ancha Mountains (Table 2). Overall average trap catch for the three plots was 2.9 moths. Average catch was highest at Reynolds Creek (7.2 moths) and lowest at Workman Creek (0 moths). Visible defoliation is not anticipated at any of these locations in 1993.

No moths were captured at the Washington Park site along the Mogollon Rim. No defoliation is anticipated in this area during 1993.

Observations

Numerous third instar larvae, and noticeable defoliation of the current years foliage of understory trees was observed at both the Icehouse and Lower Pinal sites in June 1992. Two to three larvae per branch were commonly observed on several trees. When traps were placed in July a number of fifth instar larvae and more extensive defoliation was noted.

No defoliation was detected by aerial observers during the annual insect and disease aerial detection survey, conducted in mid-September. This may have occurred for a couple of reasons. Often, light levels of defoliation (as classified from the ground) are not detectable from the air. In addition, since primarily small trees and understory trees were affected, they may not have been visible from the plane.

In early November, when traps were retrieved, only a few exited cocoons and no egg masses were found after a fair amount of searching. This may have occurred since, in light infestations, cocoons with their attached egg masses usually are scattered on the foliated twigs throughout the tree crowns. Meanwhile, in heavy infestations, they are concentrated on the lower parts of trees (Wickman et. al. 1981). We only examined the lower branches of trees so we could have missed cocoons or egg masses located higher.

FUTURE SURVEY PLANS

For the two sites in the Pinal Mountains, early instar larval sampling is recommended for 1993 in addition to the same level of pheromone trapping. Forest Pest Management personnel will conduct larval sampling in June. Larval sampling will provide a better idea of expected defoliation levels for 1993. For the Sierra Ancha Mountains no larval sampling is called for and the same level of pheromone trapping is recommended. For the Mogollon Rim area, no larval sampling is needed, however, it might be a good idea to add one more plot. In addition, in light of the population increases in the Pinals, I would recommend adding some plots in the Mt. Graham area, where DFTM is known to have occurred at low levels in the past.

Table 1. Summary of Male Douglas-fir Tussock Moths Caught in the 1992 Pheromone Trap Survey Pinal Mountain Area.

Plot Name	Location	Number of DFTM by Trap					Total	Average
		1	2	3	4	5		
Icehouse	T25NR15ES5	37	39	42	47	26	191	38.2
Lower Pinal	T25NR15ES5	-	24	39	27	40	130	32.5
					Area Total		321	
					Area Ave.		35.3	

Table 2. Summary of Male Douglas-fir tussock Moths Caught in the 1992 Pheromone Trap Survey Sierra Ancha Mountain Area.

Plot Name	Location	Number of DFTM by Trap					Total	Average
		1	2	3	4	5		
Aztec Peak	T6NR4ES27	7	0	1	0	0	8	1.6
Workman Creek	T6NR14ES33	0	0	0	0	0	0	0
Reynolds	T6NR14ES17	1	1	20	3	11	36	7.2
					Area Total		44	
					Area Ave.		2.9	

TECHNICAL INFORMATION

Douglas-fir Tussock Moth

Introduction

The biology and effects of the Douglas-fir tussock moth are described in detail by Wickman et. al. (1975) and Brookes et. al. (1978). The Douglas-fir tussock moth, Orgyia pseudotsugata (McDunough) is an important defoliator of true firs and Douglas-fir in Western North America. Outbreaks develop rapidly and then usually subside after a year or two, usually lasting for a total of 4 years. During outbreaks, defoliation can be severe.

Biology and Life Cycle

In the Southwest the tussock moth has two hosts, white fir and Douglas-fir. White fir is the preferred host in this region. Though its name may seem a misnomer in this area, Douglas-fir is the preferred host in the northern part of its range in British Columbia and northern Washington.

The tussock moth produces one generation per year. Adults appear from late July into November. While males fly, females moths are flightless and have only rudimentary wings. The female attracts males by emitting a sex pheromone. After mating she lays an egg mass which is coated with hairs. Eggs hatch in late May or early June, coinciding with bud burst and shoot elongation of host trees. Larvae then crawl to the new needle growth and begin feeding. Larvae grow and feed, passing through six instars before pupating in July. Dispersal occurs during the larval stage when young larvae can be carried by the wind.

Many natural controls exist that usually keep populations at low levels. These include insect parasites, predators, and birds. At outbreak levels, a nuclear polyhedrosis virus, along with the other mortality factors, causes collapse of tussock moth populations.

Effects

The direct effect of larval feeding is defoliation. The insect prefers to feed on the current years foliage, however, during outbreaks, both current foliage, older foliage, and even foliage of other trees and shrubs may be consumed. Heavy defoliation can result in both outright tree mortality and top-killing. In an outbreak in eastern Oregon and Washington, 39 percent of all trees were killed in heavily defoliated areas. Top-kill in these areas amounted to between 10 and 33 percent of the trees, depending on species. Growth is retarded for several years.

Ecosystem level effects of defoliation and tree mortality are many. Defoliation and tree mortality can lead to reductions in transpiration and consequently reduced soil water depletion in the short term. Streamflows can be increased after heavy defoliation. Nutrient distribution and availability can be altered. Forest plant species composition can be altered both directly and indirectly. Direct effects occur as a result of tree mortality and can result in species shifts towards nonhost tree species. Indirect effects result from environmental changes which occur following defoliation and can also result in altered plant species composition.

General Management Recommendations

Management recommendations to prevent adverse impacts from tussock moth outbreaks involve four major activities: Early detection, evaluation, suppression, and prevention. Early detection can be accomplished using either pheromone traps to catch male moths or larval sampling. Populations trends can be determined by continuous annual monitoring. Determination of appropriate environmentally acceptable, economically sound tussock moth strategies requires a good understanding of desired future conditions and resource management objectives from a site specific and a landscape perspective. The need to suppress a tussock moth population depends on the impact an uncontrolled outbreak is expected to have on the accomplishment of resource management objectives. Decisions for control must be based on thorough evaluation of the insect population (expected trends etc.) and the resource values at stake. A number of materials are registered for suppression of DFTM outbreaks. Two, Bacillus thuringiensis, and Nucleopolyhedrosis virus (NPV) are biological insecticides and are the most selective. Other chemical insecticides are more broad spectrum and may affect a greater number of organisms. Prevention of outbreaks is the ultimate goal of pest management. However, more knowledge of insect-host relations and stand dynamics is needed before specific silvicultural recommendations could be made to reduce susceptibility of host stands. There are indications that fir growing on pine sites and fir stands growing on warm, dry sites are most vulnerable to Douglas-fir tussock moth. Therefore, maintaining pine on these sites, as well as maintaining fir stands in good growing conditions, may be among the best long-term management strategies.

ACKNOWLEDGEMENTS

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Lessard, E.D. 1975. The Occurrence and Control of the Douglas-fir Tussock Moth in the Southwestern Region. USDA Forest Service, Southwestern Region, Report R-3 76-14, 5 p.

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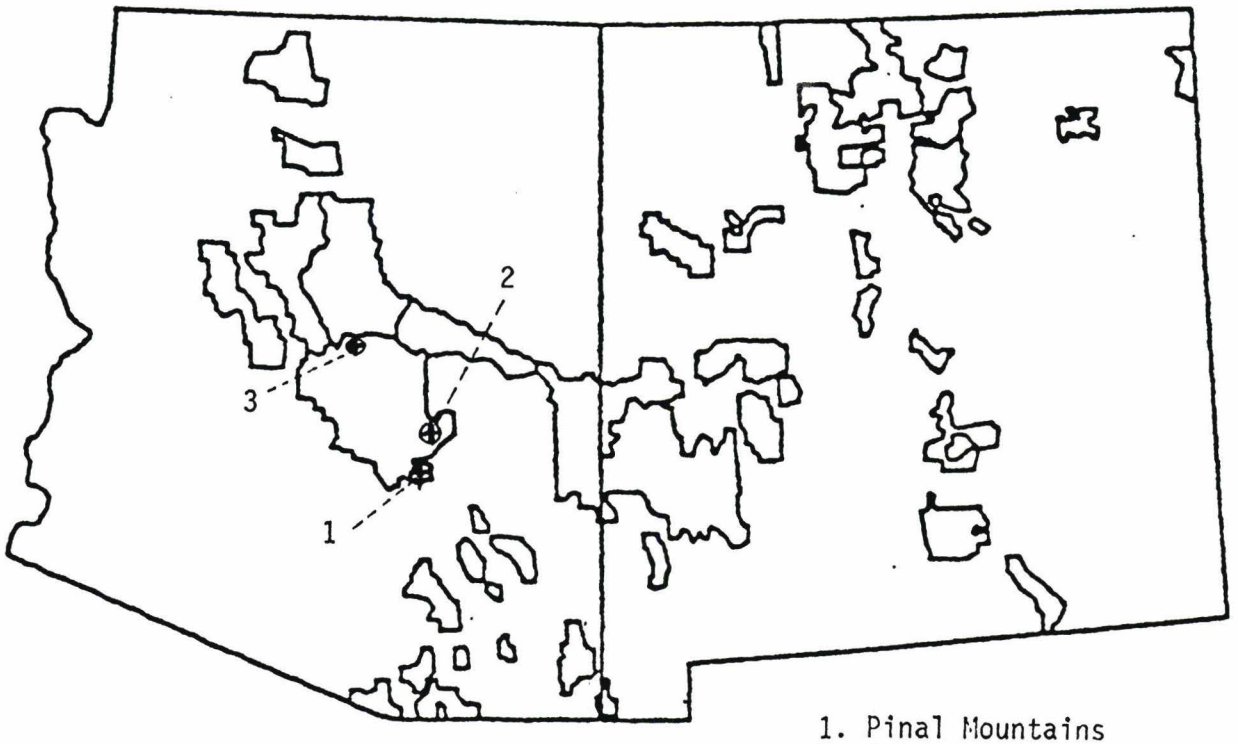
FIGURE 1

DFTM OUTBREAK EARLY WARNING
DETECTION SYSTEM SITES IN
ARIZONA, 1992



1. Pinal Mountains
2. Sierra Ancha Mountains
3. Mogollon Rim

FIGURE 2

1992 DFTM Pheromone Trap Plots
Pinal Mountains

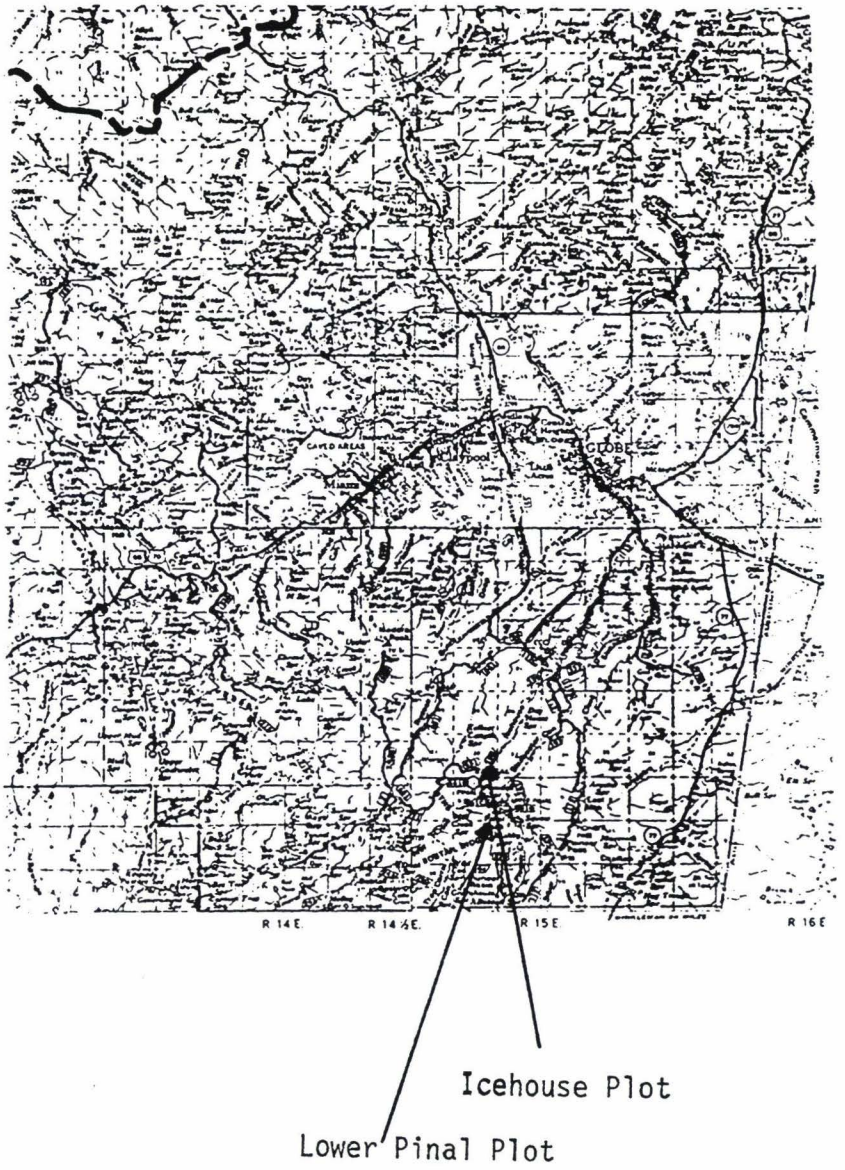


FIGURE 3

1992 DFTM Pheromone Trap Plots
Sierra Ancha Mountains

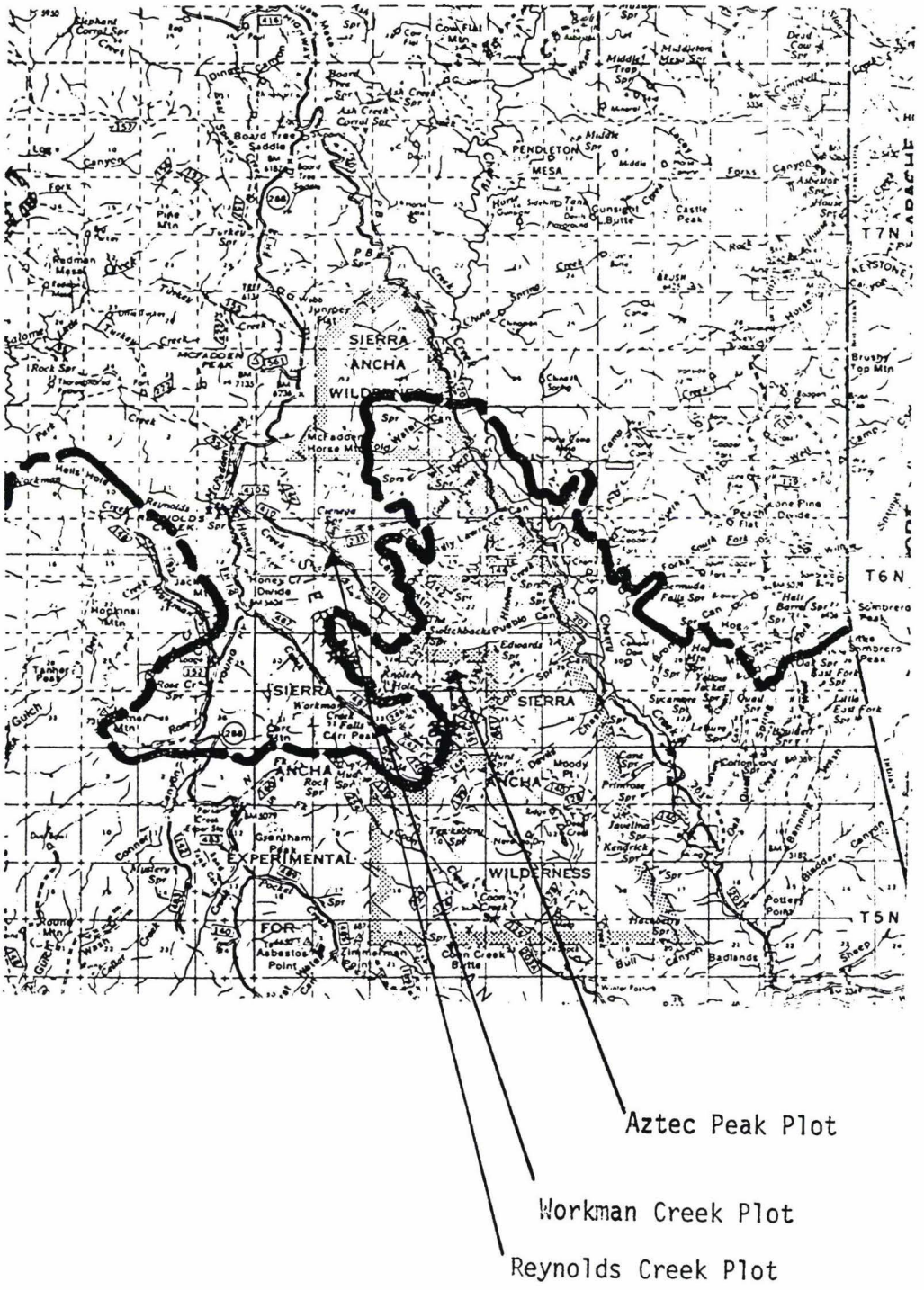


FIGURE 4

1992 DFTM Pheromone Trap Plots
Mogollon Rim